## REMARKS

Claims 1, 3, 4, and 6 are pending in this application, and have been amended to define still more clearly what Applicant regards as his invention. Claims 2 and 5 have been canceled without prejudice or disclaimer of subject matter. Claims 1 and 4 are independent.

Claims 1-6 were rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as reasonably to convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention. The Office Action states that it is not clear where in the originally filed disclosure support for "said plurality of independent potential supply portions being ohmically connected to each other through said semiconductor region" (as recited in Claim 1 prior to this Amendment) can be found. The Examiner noted that the elected species is represented in Fig. 3.

Claim 1 has been amended to recite that the semiconductor region forms a resistor, and the plurality of independent potential supply portions are connected to each other through the semiconductor region forming the resistor. In other words, the plurality of independent supply portions are connected to each other through a resistor. The resistor corresponds to the well resistor 27 shown in Figs. 5 and 10. Applicant notes that Fig. 3 is a sectional view vertically along a charge transfer region 5 in Fig. 5 (see, e.g., the specification at page 15, lines 10-12; and page 20, lines 5-10), and therefore this feature is

present in the elected species, i.e., within the well 18 of Fig. 3. The well 18 of Fig. 3 naturally includes the well resistor.[1/]

Moreover, and referring to Fig. 5, a notation of a well resistor 27 has been made to show a resistive function along potential supply terminals 12, 14, as a physical property of a well 18; there would be no discrete resistor element 27. This is supported in the specification at, e.g., page 20, lines 19-22, wherein it is stated that "the p-type well 18 receives potentials from regions 12 and 14 on the lower and upper sides in Fig. 5, and the potential of the p-type well 18 between the regions 12 and 14 is set via well resistors 27." This is a structure wherein the whole semiconductor region is depleted totally, which is different from the structure of a CCD wherein a charge is transferred step by step according to a step waveform potential formed by the voltage of plural external electrodes.

Based on the foregoing comments, Applicant respectfully requests withdrawal of the rejection under Section 112, first paragraph. It is noted that similar comments apply to Claim 4.

Claims 1-6 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 4,139,784 to Sauer.

As is explained in much greater detail in the present application, the present invention is concerned with solving a problem encountered in two-dimensional arrays of image sensing elements. Such elements are conventionally either charge-coupled devices ("CCDs") or charge-sweep devices ("CSDs"). CCDs have the drawback that high sensitivity and wide dynamic range are fundamentally incompatible aims, and typically one

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1/ It is to be understood that the claims are not limited in scope by the details of the specification, which are referred to only for purposes of ilustration.

must be sacrificed to obtain an improvement in the other. With CSDs, on the other hand, although both of these aims can both be obtained, the price is that the nature of the CSD requires line-sequential driving to read out the image that has been picked up. Various efforts to avoid this drawback of the CSD are described in the specification, but additional improvement in techniques that permit one to avoid these problems would be desirable. Such improvement is provided by the present invention.

Claim 1 is directed to a charge transfer apparatus including a semiconductor region of one conductivity type forming a resistor, and a charge transfer region of a conductivity type opposite to the conductivity type of the semiconductor region that is formed in the semiconductor region and joined to the semiconductor region to form a diode. A signal charge input portion is adapted to input a signal charge to the charge transfer region, and a signal charge output portion is adapted to accumulate the signal charge transferred from the charge transfer region. The charge transfer apparatus further includes a plurality of independent potential supply portions adapted to supply a potential gradient to the semiconductor region, the plurality of independent potential supply portions supplying the semiconductor region with respectively different potentials. The plurality of independent potential supply portions are connected to each other through the semiconductor region forming the resistor, wherein the charge transfer region is completely depleted before the signal charge is input. Moreover, the signal charge in the charge transfer region is transferred by the potential gradient formed by the plurality of potential supply portions, and the signal charge in the charge transfer region is transferred by drift over all of the charge transfer region.

Sauer, as understood by Applicant, relates to a CCD wherein the signal charge is transferred step by step along a semiconductor surface according to a potential waveform formed by the voltage applied by the electrodes formed thereon through an insulating film.

The Office Action cites Sauer's Fig. 7 for a charge transfer region (87a). Applicant respectfully disagrees with the Examiner's position. It is apparent from column 8, lines 48-52 of Sauer, that reference numerals 85 and 87 denote barrier implants, utilized under second layer gate electrodes, in order to form a potential barrier. It should be noted, too, that in two-phase driving, the signal charge can be transferred unidirectionally.

Accordingly, the signal charge is not transferred within barrier implants 87 and 85; rather, the barrier implants 87 and 85 are obstacles for preventing a reverse of the signal charge. The signal charge transfer is achieved along the N channel region 26. As is apparent from Fig. 10, within the region 26, by means of voltage applications from plural gate electrodes, a step form potential is formed, thereby transferring the charge according to CCD principles. Accordingly, the region 26 is depleted completely and therefore does not operate as a resistor like the apparatus of Claim 1.

According to Claim 1, the signal charge is not transferred to the region 18 (see Fig. 3 of this application); rather, the region 18 is operated as the larger resistor between the potential supply portions. Accordingly, a larger potential difference can be formed between the potential supply portions, to form a larger potential gradient. Within a region 5 totally depleted before the signal charge is input by a diode operation in connection with the region 18, the signal charge can be transferred at high speed. In

addition, the number of the potential supply portions can be made smaller advantageously, unlike the CCD.

In the CCD structure, since the gate electrode supplying a voltage forming potential charge for charge transfer forms a direct potential charge in the semiconductor surface thereunder through the thin insulating film, a greater potential difference such as in the apparatus of Claim 1 cannot be applied. Accordingly, it is necessary to arrange a large number of electrodes and to use plural phases of the driving voltage, in transferring the signal charge.

Based on the foregoing comments, Applicant submits that Claim 1 is patentable over Sauer.

Independent Claim 4 includes feature similar to those just described in connection with Claim 1, and is also believed to be patentable over Sauer for at least the same reasons.

A review of the other art of record has failed to reveal anything which, in Applicant's opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are therefore believed patentable over the art of record.

The other claims in this application are each dependent from Claim 1 or 4 discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

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This Amendment After Final Action is believed clearly to place this application in condition for allowance and its entry is therefore believed proper under 37 C.F.R. § 1.116. At the very least, it is believed that the formal rejection has been overcome. In any event, entry of this Amendment After Final Action, as an earnest effort to advance prosecution and reduce the number of issues, is respectfully requested. Should the Examiner believe that issues remain outstanding, he is respectfully requested to contact Applicant's undersigned attorney in an effort to resolve such issues and advance the case to issue.

In view of the foregoing amendments and remarks, Applicant respectfully requests favorable reconsideration and early passage to issue of the present application.

Applicant's undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,

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